U. S. FOREST SERVICE

RESEARCH NOTE NC-66

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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DEER BROWSE PRODUCTION: RAPID SAMPLING AND COMPUTER-AIDED ANALYSIS

ABSTRACT. — Describes field techniques by which winter deer-browse production can be sampled with reasonable accuracy and moderate effort; and presents a computer program which simplifies and expedites the tabulation of the browse data. The method will be useful to both land managers and scientists doing research on the habitat of the white-tailed deer.

Determining the potential value of forest stands for wildlife habitat is a complex and time-consuming process. This Note, which is based on our experience in sampling woody material used as winter browse by white-tailed deer, is a contribution towards simplifying the collection and analysis of data on browse production.

After the variables to be measured have been chosen, the principal steps in estimating browse production are: developing a sampling scheme, collecting data in the field, and analyzing the data. We have concentrated on measuring the total quantity of browse available, past browse utilization, the number of stems of each browse species, and the basal area of the overstory as estimated by prism from each plot center.

Field plots must be large enough to permit adequate sampling of major browse species but small enough so that boundaries can be readily established in dense undergrowth. The quality of the plot estimates must be balanced against the cost of making those estimates. After some experimentation, we chose a ¼-milacre (.00025 acre) plot as the most efficient size, for larger plots often require excessive time to count and clip. (A smaller plot might be necessary when working with low, dense browse.) Such a plot can be outlined easily with a pair of plot sticks 3.3 feet long. They are held at right angles to form two boundaries of a square plot, with their intersection at the sample point. Square plots seem best adapted to sampling browse in forest stands, but a circular plot is often more efficient in low or open vegetation.

Although sampling intensity could be varied with the nature of the forest stands, we settled for the convenience of a constant number of plots per stand. Since most trees and shrubs are not uniformly distributed throughout a stand, the variation between plots within a stand is often large. Furthermore, the utilization of browse material by deer also varies greatly both between years and between areas of similar plant composition for any given year. Therefore, a sampling error of about 20 percent of the mean seems a reasonable goal. To attain this precision, 30 to 40 plots per stand are usually adequate.

Sample plots can be quickly laid out. Along one boundary of the stand, points are established from which to start transects. Then the plots are laid out along each transect at predetermined intervals. If a more sophisticated sampling scheme is desired, the transects could be established at random intervals on the stand boundary, or the plots at random intervals on the transects, or both. For our purposes, an ordinary grid with uniform intervals was satisfactory.

On each plot the first step is to count the number of stems rooted in the plot for each browse species. It is usually easiest to record the most abundant species first. Past browsing is noted by assigning one of four browsing categories based on the percentages of the terminal twigs which were browsed in the previous winter: (1) no browsing, (2) up to one-third of the stems browsed, (3) one-third to two-thirds browsed, and (4) over two-thirds of the stems browsed.

When the browsing index has been recorded, the browse in the plot is clipped. Our definition of woody browse as all current annual growth between 1 and 7 feet above the ground provides a maximum estimate. This includes browse which extends into the (three-dimensional) plot from stems rooted outside. However, twigs less than 1 inch long are not clipped, for they are seldom browsed and contribute little to total production. Their elimination greatly reduces the time required to clip the plots.

The browse material is placed in bags by species and either weighed immediately to determine fresh green weight or dried and then weighed to provide air-dry or ovendry weight.

A form to facilitate field measurements and the subsequent analysis of these data is shown in figure 1. Standard alphabetic abbreviations are utilized to identify the sampled trees and shrubs (table 1).

The field data are transferred from these forms onto standard 80-column punch cards for analysis by a specially prepared computer program. The field form does not have to rigidly follow the one illustrated, for the user can specify either fewer or more digits for each measurement. However, the *order* of the input variables is fixed as shown.[1] Plot size and, if desired, a factor (which must be a constant) for converting green weights to dry weights are also punched.

Other characteristics of the computer program are that:

1. A single plot or stand can contain as many as 50 species.
2. Any number of plots can be included in a stand.
3. The measurements for a single plot can be recorded on any number of punch cards.
4. Plot size must be constant within a stand but can be varied between stands.
5. Any number of stands can be processed in a single computer run.

[1] *Although table headings are always printed with the indicated names for the program variables, any other measurements could be recorded in their place. For example, stand stocking, percent germination by species, and shoot length and weight could be substituted.*

Stand _____

Location _____ Acreage _____ Type _____

Remarks _____

Date _____ Crew _____

Plot No.			BA		Species			No. stems			BC	Browse wt.					Species				No. stems			BC	Browse wt.				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

BA--basal area of overstory from plot center using a prism (in tens of square feet).
No. stems--stems rooted in plot, taller than 12 inches but less than 1.5 inches d.b.h.
BC--browsing category: 0 = no browsing, 1 = less than 1/3 terminals browsed, 2 = 1/3 to 2/3 browsed, 3 = more than 2/3 terminals browsed.
Browse wt.--either fresh or dry weight (in grams).

Figure 1. — Sample form for recording field data.

Table 1. — *Standard abbreviations for some commonly browsed trees and shrubs of the northern Lake States*

Abbreviation 1/ and scientific name 2/	Common name
ABBA - *Abies balsamea*	Balsam fir
ACRU - *Acer rubrum*	Red maple
ACSA - *Acer saccharum*	Sugar maple
ACSP - *Acer spicatum*	Mountain maple
ALRU - *Alnus rugosa var. americana*	Speckled alder
AMLA - *Amelanchier laevis*	Juneberry
BELU - *Betula lutea*	Yellow birch
BEPA - *Betula papyrifera*	Paper birch
CACA - *Carpinus caroliniana*	Bluebeech or hornbeam
COAM - *Corylus americana*	Hazelnut
COCO - *Corylus cornuta*	Beaked hazelnut
COAL - *Cornus alternifolia*	Alternate-leafed dogwood
COST - *Cornus stolonifera*	Red-osier dogwood
DIPA - *Dirca palustris*	Leatherwood
FAGR - *Fagus grandiflora*	American beech
FRAM - *Fraxinus americana*	White ash
FRNI - *Fraxinus nigra*	Black ash
ILVE - *Ilex verticillata*	Winterberry
OXVI - *Ostrya virginiana*	Ironwood or hophornbeam
PIBA - *Pinus banksiana*	Jack pine
PIRE - *Pinus resinosa*	Red pine
PIST - *Pinus strobus*	White pine
POGR - *Populus grandidentata*	Large-toothed aspen
POTR - *Populus tremuloides*	Quaking aspen
PRPE - *Prunus pensylvanica*	Pin cherry
PRSE - *Prunus serotina*	Black cherry
PRVI - *Prunus virginiana*	Chokecherry
PRPU - *Prunus pumila*	Sand cherry
QUAL - *Quercus alba*	White oak
QUBO - *Quercus borealis*	No. red oak
QUEL - *Quercus ellipsoidalis*	Jack oak (no. pin)
QUVE - *Quercus velutina*	Black oak
RHTY - *Rhus typhina*	Staghorn sumac
RHGL - *Rhus glabra*	Smooth sumac
SAAL - *Sassafras albidum*	Sassafras
SANI - *Salix nigra*	Black willow
SACA - *Sambucus canadensis*	Common elderberry
SAPU - *Sambucus pubens*	Red-berried elder
THOC - *Thuja occidentalis*	White-cedar
TACA - *Taxus canadensis*	Canada yew
TIAM - *Tilia americana*	Basswood
TSCA - *Tsuga canadensis*	Eastern hemlock
ULAM - *Ulmus americana*	American elm
VILE - *Viburnum lentago*	Nannyberry

1/ Abbreviations are formed from the first two letters of the genus name followed by the first two letters from the species name. When a particular combination has already been used, a new combination should be made using other letters. Initially, unidentified species were designated by the first two letters of the genus name followed by Sp. This resulted in some duplication with legitimate names so the letters XX are now used to designate an unidentified species (or group of species) in any genus; for example, BEXX indicates Betula spp.

2/ Names follow C.O. Rosendahl, 1955. Trees and shrubs of the Upper Midwest. 411 pp. University of Minnesota Press, Minneapolis.

Output generated by the computer program includes both summaries of the field measurements and simple statistics (fig. 2). The first table provides plot summaries and serves as a permanent record of the data. The second is similar, but the summaries are by species rather than plots. The final table provides means, standard errors of the means, and the coefficients of variation for basal area, stem count, and browse weight, using plots as the sampling units.

The computer program is written in Fortran II specifically for the computers of the University of Minnesota. Other machines can be used if they permit three-dimensional arrays and a variable data format (not in source program), and have a core storage capacity of 8,000 data items in addition to compiler requirements. Listings of the Fortran source deck and program documentation are available from the Biometrical Section of this Station.

The time required for field work varies greatly with the vegetation, but approximates 1.5 man-days per stand. The computer program has been used successfully to summarize field data on a number of stands in Wisconsin and Michigan. It has vastly reduced the time required to calculate the availability of browse and other measures.

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NORTH CENTRAL FOREST EXPERIMENT STATION
FOREST SERVICE (U.S.D.A.)

BROWSE ANALYSIS

T44N R5W SWSE-28 SE-26 NOV. 9, 1964 41 ACRES(EST.) MD ACTUAL MD CH1
(WEIGHT INCLUDES OVERHANGING BRANCHES)

NSPC = 5 PLOT SIZE = .00025 ACRES FIELD TO DRY WEIGHT CONVERSION FACTOR = .5300

DATA FORMAT = (I3, F2.0, 5(A4, F3.0, F1.0, F5.2))

INDIVIDUAL PLOT SUMMARIES (RECORDED WEIGHTS - RECORDED BASAL AREA TIMES 10)

PLOT	BASAL AREA	PLOT STEMS	AVE BROWSE DAMAGE	RECORDED PLOT WEIGHT	SPECIES OCCURING ON PLOT
101	9.00000E+01				
102	1.10000E+02	0.	0.	5.00000E-01	FRNI
103	1.20000E+02	3.00000E+00	2.00000E+00	0.	ACRU
104	5.00000E+01	1.00000E+00	3.00000E+00	5.00000E-01	BEPA
105	1.00000E+02	1.20000E+01	2.00000E+00	5.00000E-01	ACSA ACSP PRSE
106	8.00000E+01				
107	9.00000E+01	2.00000E+00	0.	1.00000E+00	PRSE
108	1.00000E+02	0.	3.00000E+00	5.00000E-01	ACSA
109	9.00000E+01	2.00000E+00	3.00000E+00	5.00000E-01	ACSP
110	8.00000E+01	5.00000E+00	3.00000E+00	4.00000E+00	ACSP
201	9.00000E+01	6.00000E+00	1.50000E+00	1.10000E+01	COCO ACSP
202	7.00000E+01	4.00000E+00	0.	1.00000E+00	OSVI
203	1.00000E+02	1.00000E+00	1.50000E+00	2.00000E+00	ACSP OSVI
204	7.00000E+01	2.00000E+00	3.00000E+00	5.00000E-01	ACSA ACSP
205	1.10000E+02	2.00000E+00	3.00000E+00	1.00000E+00	ACSA ACRU ACSP
206	1.20000E+02	7.00000E+00	1.66667E+00	1.00000E+00	ACRU BEPA TSCA
207	1.20000E+02	1.20000E+01	2.66667E+00	4.00000E+00	ACRU ACSA BEPA
208	3.00000E+01	2.00000E+00	2.00000E+00	2.50000E+00	ACRU BEPA ALXX
209	1.10000E+02	2.00000E+00	1.50000E+00	5.00000E-01	ACSA FRNI
210	9.00000E+01				
211	1.20000E+02				
212	9.00000E+01	1.40000E+01	3.00000E+00	6.00000E+00	ACSA
213	8.00000E+01	6.00000E+00	1.00000E+00	2.00000E+00	ACSA OSVI ACRU
214	1.40000E+02				
215	8.00000E+01	4.00000E+00	1.50000E+00	6.00000E+00	ACSA OSVI
216	1.20000E+02	2.00000E+00	0.	2.00000E+00	ACSA OSVI
301	7.00000E+01				
302	1.00000E+02	6.00000E+00	0.	5.00000E-01	ACSA OSVI
303	8.00000E+01	1.00000E+01	2.50000E+00	1.00000E+00	ACSA ACRU
304	9.00000E+01				
305	7.00000E+01	7.00000E+00	3.00000E+00	2.00000E+00	ACSA
306	7.00000E+01				
307	7.00000E+01				
308	7.00000E+01	1.30000E+01	2.00000E+00	1.50000E+00	ACSA FRXX ACSP
309	1.10000E+02	4.00000E+00	2.50000E+00	1.50000E+00	ACSA ACRU
310	7.00000E+01	4.00000E+00	1.00000E+00	1.00000E+00	ACSA ACRU BEPA
401	1.10000E+02				
402	7.00000E+01	2.00000E+00	1.50000E+00	0.	FRXX TIAM
403	6.00000E+01	6.00000E+00	5.00000E-01	1.00000E+00	ACSA PRSE
404	9.00000E+01	1.00000E+00	0.	0.	ACSA

8.950000E+01 = AVERAGE BASAL AREA 40 = TOTAL NUMBER PLOTS 12 = TOTAL NUMBER SPECIES

INDIVIDUAL SPECIES SUMMARIES (WEIGHT IN GRAMS)

SPP	NUMBER OF PLOTS	PERCENT OF PLOTS	TOTAL STEMS	STEMS PER ACRE	PCT STAND STEMS	AVE BROWSE DAMAGE	TOTAL DRY WEIGHT	DRY WEIGHT PER STEM	DRY WEIGHT PER ACRE	PCT STAND DRY WT
FRNI	2.00000E+00	5.0000	1.00000E+00	1.00000E+02	.7042	0.	2.65000E-01	2.65000E-01	2.65000E+01	.9009
ACRU	9.00000E+00	22.5000	2.10000E+01	2.10000E+03	14.7887	2.22222E+00	2.12000E+00	1.00952E-01	2.12000E+02	7.2072
BEPA	5.00000E+00	12.5000	8.00000E+00	8.00000E+02	5.6338	2.80000E+00	1.32500E+00	1.65625E-01	1.32500E+02	4.5045
ACSA	1.80000E+01	45.0000	6.80000E+01	6.80000E+03	47.8873	2.05556E+00	1.11300E+01	1.63676E-01	1.11300E+03	37.8378
ACSP	8.00000E+00	20.0000	1.90000E+01	1.90000E+03	13.3803	3.00000E+00	4.50500E+00	2.37105E-01	4.50500E+02	15.3153
PRSE	3.00000E+00	7.5000	7.00000E+00	7.00000E+02	4.9296	0.	5.30000E-01	7.57143E-02	5.30000E+01	1.8018
COCO	1.00000E+00	2.5000	6.00000E+00	6.00000E+02	4.2254	0.	4.77000E+00	7.95000E-01	4.77000E+02	16.2162
OSVI	6.00000E+00	15.0000	7.00000E+00	7.00000E+02	4.9296	0.	3.71000E+00	5.30000E-01	3.71000E+02	12.6126
TSCA	1.00000E+00	2.5000	1.00000E+00	1.00000E+02	.7042	0.	0.	0.	0.	0.0000
ALXX	1.00000E+00	2.5000	0.	0.	0.0000	0.	5.30000E-01	0.	5.30000E+01	1.8018
FRXX	2.00000E+00	5.0000	3.00000E+00	3.00000E+02	2.1127	0.	5.30000E-01	1.76667E-01	5.30000E+01	1.8018
TIAM	1.00000E+00	2.5000	1.00000E+00	1.00000E+02	.7042	3.00000E+00	0.	0.	0.	0.0000
			1.42000E+02	1.42000E+04	100.0000	8.16667E+00	2.94150E+01	2.07148E-01	2.94150E+03	100.0000

SELECTED STATISTICS ON AN ACRE BASIS (PLOT IS SAMPLING UNIT)

	MEAN	STANDARD ERROR OF MEAN	ERROR AS PERCENT OF MEAN
BASAL AREA	8.950000E+01	3.543683E+00	3.959423E+00
NUMBER STEMS	1.420000E+04	2.529619E+03	1.781422E+01
DRY WEIGHT (GRAMS)	2.941500E+03	7.275785E+02	2.473495E+01
DRY WEIGHT (LBS)	6.484903E+00	1.604037E+00	2.473495E+01

Figure 2. — Sample computer printout generated by browse program.